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Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

The Development of Automatic Lubrication

PUBLISHED MONTHLY BY
THE TEXAS COMPANY, U.S.A.
TEXACO PETROLEUM PRODUCTS

The Tools of Lubrication

TO be thoroughly versed in the Science of Lubrication implies a familiarity with the "Tools of Lubrication."

Automatic lubricators and automatic lubricating devices may be called the tools of lubrication.

As such they are important.

Therefore, we have attempted to crowd into these pages a general survey of the most widely used types of lubricating devices, and a description of their functions.

We believe that this article will help round out the existing information on the subject of lubrication and believe it important enough to warrant devoting an entire issue to this subject.

* * *

In all fairness to the other responsible manufacturers of lubricating devices we wish to state explicitly that the illustrations used in our article do not imply that this equipment is featured to point out any particular preference or special recommendation on our part.

The cuts we show are intended only to give the reader an impression of a "typical" device.

* * *

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The Development of Automatic Lubrication

THE extensive development of industrial machinery and the tendency towards the adoption of higher speeds and pressures in practically every phase of machine operation have brought about many marked improvements in accessory equipment. None have been more outstanding, however, than automatic lubricating devices. There was a time when the manner of application of lubricants to moving parts subjected to friction, was regarded as relatively unimportant, but this was in the day when any old lubricant was considered good enough just as long as it appeared to oil the wearing surfaces more or less. It was soon found out, however, that if efficient operation was to be obtained under the higher speeds and pressures which were becoming necessary, the means of applying the lubricant must be given quite as much consideration as the lubricant itself. In brief, we had to insure not only the constant and efficient operation of machinery, but also the mechanical and positive usage of our lubricants and the maintenance of repair expense at a minimum. Regardless of how carefully the lubricant had been refined or selected, if it was not properly used it could not meet the requirements necessary; so automatic means of lubrication came gradually into usage to replace the old methods of hand oiling.

To-day, as a result, lubrication is universally regarded as one of the most important features with which the engineer will have to deal. In fact, we can practically say that lubrication has developed into a science, and we can no longer regard the selection of lubricants as a minor detail nor their means of application as simply a necessary evil. Therefore, proper lubrication systematically carried out by means of lubricating equipment so designed as to meet every requirement of the machine on which it is to be used, is one of the outstanding features of modern plant operation.

It is interesting to note the development of automatic lubrication by a study of the various devices that have been involved. Of necessity this development has been more or less of an evolution inasmuch as it has had to follow the trend of machine design and production requirements. Essentially, automatic lubrication can be grouped into nine classifications, according to the means by which the desired results are brought about. In general they will include:

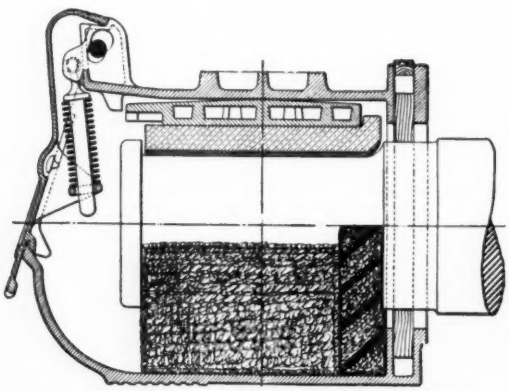
1. Waste pad lubrication.
2. Individual lubricating devices, involving sight feed drip cups, bulls-eye lubricators and compression grease cups.
3. Wick feed oiling devices.
4. Self-oiling systems, which include ring, chain and collar oilers.
5. Gravity feed systems.
6. Force-feed lubricating systems.
7. Mechanical force feed lubricators.
8. Lubrication by means of splash methods.
9. Hydrostatic lubricators.

WASTE PAD LUBRICATION

Perhaps the simplest means of attaining certain of the benefits of automatic lubrication

involves the use of pads of oil-soaked waste or felt. In fact waste pad lubrication was one of the earlier developments. As higher speeds and pressures began to come into usage, the application of oil by means of oil cans proved relatively unsatisfactory and certainly not dependable. Oil applied by hand does not remain in the bearings for any length of time, but soon drains out to leave the wearing surfaces insufficiently lubricated until the next application.

As a result, in order to obtain better economy and service from the oil, it was found that the caps could be built with a shallow reservoir having oil holes drilled in the bottom, extending down through the bearing metal. Thus a pad of waste could be laid in such a reservoir and periodically saturated with oil. This pad not only prevented dust, dirt or any other foreign matter from gaining access to the bearing and causing trouble, but also prevented oil from flowing too rapidly into the bearing and running through before it had completely served its purpose. Oftentimes, instead of waste, a pad of felt was cut to the shape of the oil reservoir.



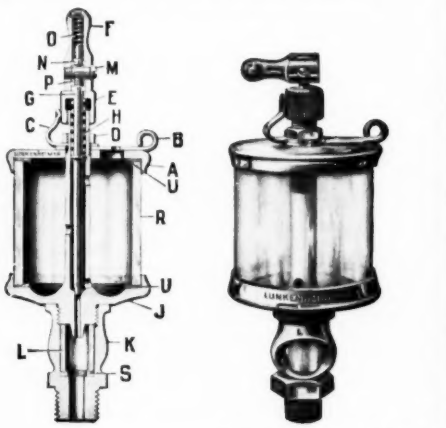
Courtesy of McCord Manufacturing Co., and J. C. Stewart.

Fig. 1.—A car wheel journal box with oil-saturated waste packing in place around lower half of the journal.

Waste pad lubrication is to-day still in use on many types of machinery for reasons of economy or where higher pressure and limited space is involved, and it is desirable to obtain the maximum of bearing surface and eliminate the necessity of having to cut extensive oil grooves.

Car Wheel Journal Lubrication.

A modified form of waste pad lubrication is employed in electric and steam railway service for oiling the car wheel journals and armatures. One of the most important problems which must be overcome in the operation of railway rolling stock is the prevention of hot boxes. In such equipment the load is carried by a top bearing or brass; the bottom of the journal box being built with a reservoir in which oil-saturated waste can be packed up to the level of the centre-line of the journal. As the latter rotates in contact with this waste it carries a film of lubricant to the bearing.



Courtesy of The Lunkenheimer Co.

Fig. 2.—A sight feed oiler of the glass body snap feed lever control type. "F" is feed control lever; "G" is the feed valve stem; and "R" is the glass body.

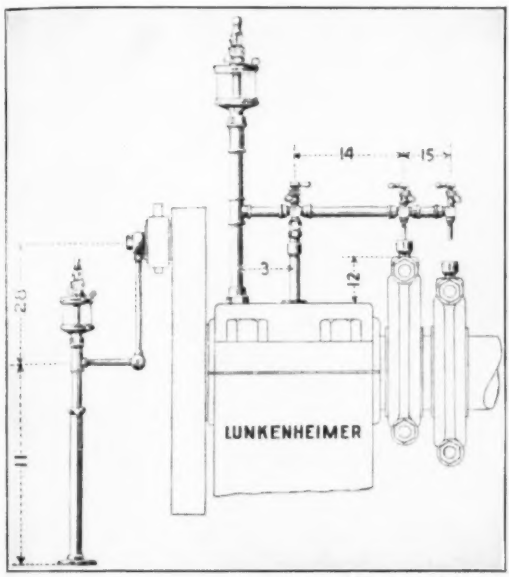
This waste packing should always be installed in a homogeneous mass. In other words, a sufficient amount of packing should be taken to completely fill the space below the journal, as shown in figure 1. This waste should be so intimately knitted together that it will remain in proper position in the bearing. Unless properly packed, the resultant lateral motion of the journal may work the waste out of place, often even to the extent of forcing off the lid of the journal box.

In any form of waste pad lubrication much depends upon the resiliency or elasticity of the waste and its ability to retain oil. Naturally if it becomes caked or packed down with dirt or dust, it will not function properly. Especially in car wheel journal lubrication is this a factor as the phenomenon of capillary attraction is involved in the passage of the oil through the strands of waste.

INDIVIDUAL LUBRICATING DEVICES

The sight feed oil cup, bottle oiler and compression grease cup, etc., were developed to serve as individual means of lubrication in order to obtain longer and more automatic service from lubricants. They were among the earlier devices installed to overcome the discrepancies of hand oiling, proving so effective that they have retained their popularity to the present time. They are in fact, the pre-

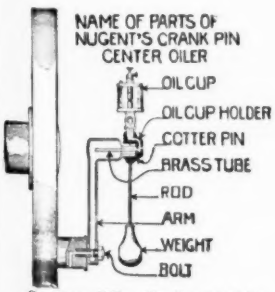
ferred recommendation for the lubrication of many types of plant machinery. In stationary practice they are especially advantageous over the waste pad in that they eliminate the necessity for more or less frequent attention. In other



Courtesy of The Lunkenheimer Co.

Fig. 3.—Sight feed lubricating equipment adapted for oiling crank pin, pillow block and eccentrics.

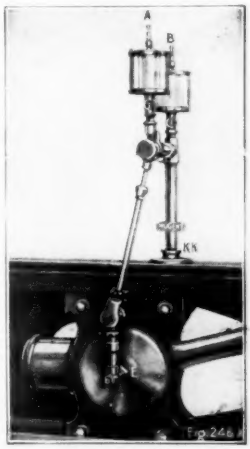
words, as long as they are kept properly filled and adjusted, they can be always relied upon to furnish the requisite amount of lubricant to the bearings. In the case of the sight feed oil cup, however, in order to insure dependable action, it must be kept properly cleaned, for it will often clog up with small particles of dust or dirt. Furthermore, it must be stopped by hand whenever the machine is stopped, usually by a simple adjustment of the feeding lever; otherwise the oil will continue to run into the bearing and when the machine is started again, the cup may perhaps be empty.



Courtesy of Wm. W. Nugent & Co.

Fig. 4.—A crank pin center oiler showing details of construction.

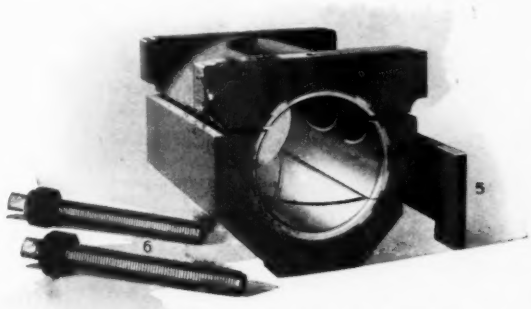
The bottle oiler, however, is entirely automatic in operation, its feed of lubricant depending upon the motion of the shaft. In other words, oil flows only when the shaft is in rotation. Also, according to the temperature of the shaft more or less oil will be fed; i. e., the hotter the shaft, the hotter the needle, therefore, the thinner the oil and the greater its flow. Shaft vibration also promotes increased flow of oil. In fact, one of the principles of the bottle oiler is based upon irregularities in the periphery of the shaft during rotation, and the consequent more or less reciprocating motion of the oiler needle.



Courtesy of Wm. W. Nugent & Co.

Fig. 5—A telescopic positive feed crosshead pin and top guide oiling device, using sight feed oil cups.

Sight feed oil cups are perhaps the most extensively used of any of the more simple lubricating devices. They are cheap and are adaptable to equipment where bearing pressures are not abnormal and temperatures and speeds are not too high. They are usually built in a varying number of sizes, but generally not above one quart in capacity, and are equipped with a sight feed device (as at "L" in Fig. 2), which enables the operator to observe the rate of flow of his oil. Although they are quite extensively used, it must be remembered that they have certain disadvantages in that variations in the oil feed will be prevalent, dependent upon the oil level in the reservoir, changes in temperatures (which naturally will tend to render the oil more or less sluggish as the case may be) and the cleanliness of both the oil and the lubricator. There are also many cases existing where they will not be adaptable owing to the location of the parts requiring lubrication. In other words, they should not be used on any bearing where it might be necessary to stop the machinery



Courtesy of The Vilter Mfg. Co.

Fig. 6.—Details of a four-piece bearing showing oil grooves. Bearings of this type are commonly used with sight or force feed lubricating devices.

in order to refill them or make any of the necessary adjustments. The compression and pin type grease cups are, therefore, often preferred. They came into usage along with sight feed oiling devices and are to-day extensively used with great satisfaction. The grease cup, whatever its type, has certain natural advantages over the sight feed oiler, in that it will furnish lubrication for a considerable period of time without refilling, and many of them are even so designed as to work absolutely automatically and require little or no adjustment.

The compression grease cup supplies grease to a bearing by virtue of a certain amount of pressure which is exerted upon the grease either by a screw-down cap or a spring actuated plunger within the cup. Thus, regardless of the movements of the shaft, a thread of lubricant is continuously available for service, as long as there is any in the cup. The pin or needle type of grease cup, on the other hand, depends upon the heat developed in the bearing to thin down the grease until it is sufficiently fluid to run down the pin. Usually this latter is of brass or copper; one end rests lightly on the shaft, the other projecting into the cup and serving as a heat conductor. Thus gravity, vibration and heat bring about a sufficient flow of lubricant to effectively serve the bearing.

Courtesy of Royersford Foundry & Machine Co., Inc.

Fig. 7.—Solid or one-piece bearing with reservoir for either hand or waste pad oiling.

Oil and grease cups, however, always require a certain amount of time and labor when being refilled. As a result, a central oil tank or manifold, of perhaps several gallons capacity, is frequently used instead of a number of individual sight feed oil cups. A manifold of this nature affords a central source of supply for the entire system. It is usual practice to install it adjacent to or upon the machine to be lubricated, at a sufficient height above the wearing parts to enable the oil to flow by gravity to each of these and to penetrate throughout the bearings. The leads to each of the parts requiring lubrication, consist of suitable piping connected to the bottom of the manifold and equipped with sight feed or bulls-eye devices, in order to enable the flow of oil to be noted.

Courtesy of Nathan Mfg. Co.

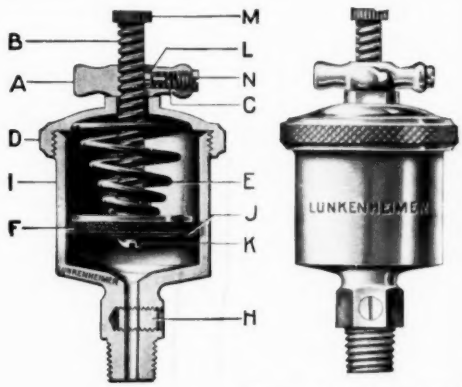
Fig. 8.—A self oiler or so-called bottle oiler, which is positive in action and economical. No oil can flow when the machinery is not in motion. Being air-tight, oil does not tend to gum in such a lubricator.

Each oil lead is also usually fitted with a control valve whereby the oil supplied can be regulated independently.

A manifold system of sight feed lubrication is advantageous in that the oil pipes can be led to bearings which would be practically out of reach of the operator, while the machine is in operation. There are normally no extensive variations in temperatures to affect the viscosity of the oil and the entire apparatus can be filled, cleaned or adjusted very much more readily and rapidly than a series of independent sight feed oil cups.

WICK FEED OR SIPHON LUBRICATION

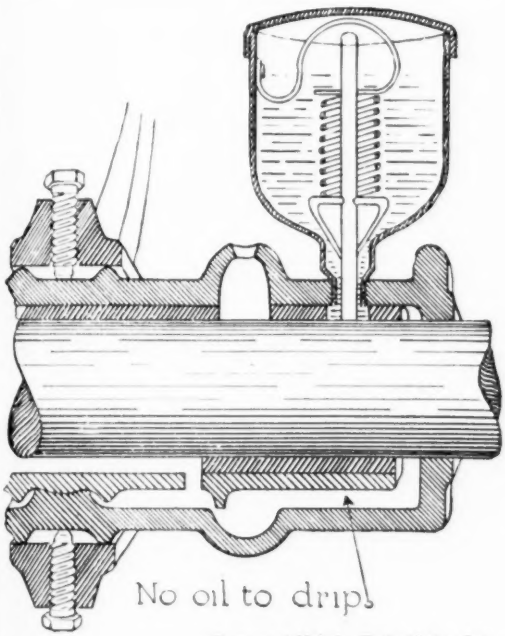
In order to attain the positive results of the sight feed oiler, as well as certain of the economies of waste pad lubrication, the use of wicks to transmit or siphon oil from a reservoir or manifold above the bearing into the oil ducts is often resorted to. Wick feed systems will be understood by many to apply distinctly to marine installations. On the other hand, they are very often used in stationary and industrial service to-day. A wick feed system consists of a manifold or oil storage reservoir, which is usually located upon the bearing or unit to be lubricated. Otherwise, this manifold is connected by brass pipes to the various parts to be served, the manifold ends of these pipes projecting through the bottom of the tank to with-



Courtesy of The Lunkenheimer Co.

Fig. 9.—A compression grease cup of the automatic feed type. "F" is a leather packed plunger, under pressure of a steel spring "E." The regulating screw "H" controls the delivery of lubricant into the bearing. "A" is the control handle, "B" the plunger stem, and "L," "C," and "N" a spring locking mechanism to prevent alteration of plunger adjustment, due to vibration.

in an inch or two of the top. They should always be above the oil level. The lubricant is fed into these pipes by means of wicks of worsted yarn. At one end of each wick is usually

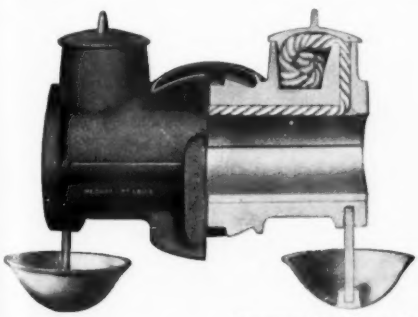


Courtesy of Malcolm H. Smith Co., Inc.

Fig. 10.—A spring type of grease lubricator which is entirely automatic in action, functioning only when the shaft is in motion.

attached a lead sinker, the other end being wound around with wire. The weighted end during operation is immersed in the oil in the manifold, the wired end leading into the oil feed ducts. As a result, the oil is able to pass up through the strands of each wick by capillary action of the latter, working its way up over the top of the oil duct, to subsequently drop from the wired end of the wick and be distributed to the particular bearing involved.

Wick or siphon lubricators are relatively impossible of adjustment or control of the oil



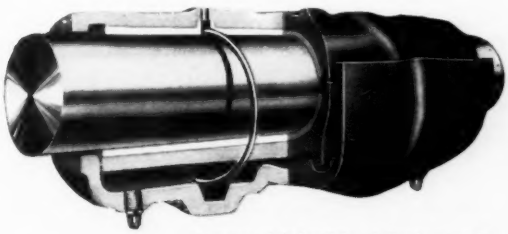
Courtesy of The Medart Company.

Fig. 11.—A type of wick oiling hanger bearing wherein the wick is in direct contact with the shaft. Drip cups are installed to catch any surplus oil which may leak from the ends of the bearing.

flow, other than by changing the oil level or the number of strands of wick used. Furthermore, starting and stopping of the oil flow is contingent upon the position of the wicks, i. e., when inserted in the distribution pipes, oil will flow continuously regardless of whether the machine is operating or not. Some designs of wick oilers, therefore, have stop cocks inserted in the oil distributing lines.

Perhaps one of the most important features in the attainment of automatic lubrication by means of wick feeds is the care they receive during operation. In fact, wick lubrication can only be absolutely positive and automatic if the wicks are removed from the system at least once every hour, and pulled or stripped through the fingers in order to prevent the oil from gumming or hardening within the strands; this is especially true where compounded oils are used. Such formations would, of course, tend to clog the oil pipes and retard lubrication. It is also advisable to use comparatively shallow reservoirs, both to facilitate siphoning action by reducing the height over which the oil is to be lifted, and to prevent deposits from collecting in the bottom.

The number of strands to be used in a wick is also important. For example, if too many are used or if the wick is too heavy, we will



Courtesy of Dodge Sales & Engineering Co.

Fig. 12.—Details of a ring-oiled bearing showing relation of the ring to the journal, and the constructional features of the bearing and oil reservoir.

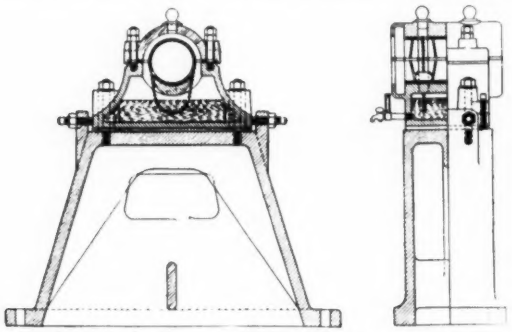
not obtain effective capillary action. As a result, wick feed lubrication in general requires considerable intelligence in its application, and it should not be used without due consideration of the machinery involved and its adaptation to operating conditions.

It is also important to remember that new wick strands when exposed to the air, tend to absorb moisture. This is a detriment to effective capillary attraction, inasmuch as moisture impedes the ultimate free flow of oil. All wicks should therefore be thoroughly dried prior to usage, and then saturated with oil.

RING, CHAIN AND COLLAR OILERS

Any of the aforementioned systems of lubrication, however, usually do not permit of the oil being collected and used over and over

again, unless an elaborate system of catch-basins is installed. As a result, in order to obtain the maximum of lubrication from the oil used, ring, chain or collar-oiled bearings are



Courtesy of Skinner Engine Co.

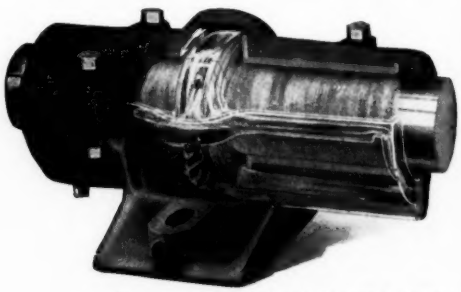
Fig. 13.—Details of a chain oiled bearing showing the extent to which the chain is in contact with the shaft, and the comparative size of the oil reservoir.

employed. Lubrication of bearings by all of these devices has proven so dependable, so satisfactory, and so capable of meeting machine operating requirements, that their usage is extensively prevalent on such high speed machinery as electric generators, motors, smaller turbines, exciters, line shaft hangers and the main bearings of many oil engines, where plain bearings are involved. The essential advantages which oilers of this nature possess over sight or drop feed lubricators are:

(a) Greater cleanliness,
(b) Economy of oil,
(c) Greater dependability,
(d) Uniformity in oil distribution, and
(e) Necessity of little care and attention.

The ring, chain or collar oiler comprises a bearing housing which is built with a reservoir below and a slot of sufficient width and depth in the upper half to permit one or more chains, rings or collars suspended or attached to the shaft, to revolve therein. As a result, with the revolution of the shaft, these latter being subjected to rotation, will carry a certain amount of oil to the top of the shaft from whence it is able to flow into the bearing oil grooves and clearance space to be ultimately distributed to the entire wearing surface. As a rule, the oil, after being passed through the bearing, will flow out to the end or ends of the shaft and back to the oil reservoir below, through a suitable return channel which is part of the bearing housing.

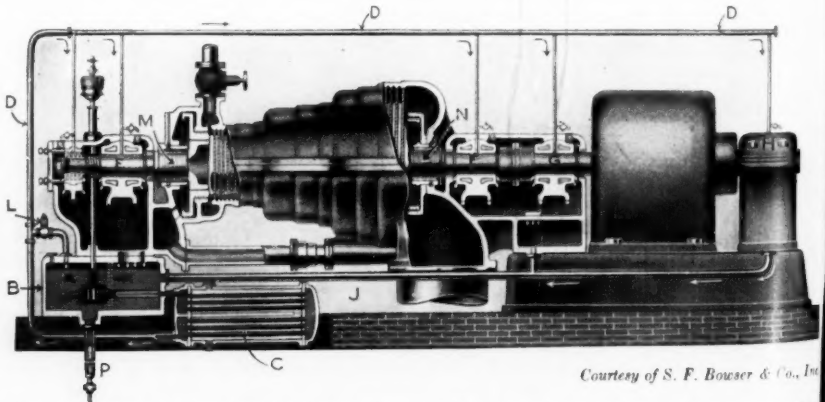
Ring oilers are not recommended for smaller bearings, especially where high speeds are involved, due to the occurrence of excessive slippage of the rings, and the possibility of foaming arising in the oil where reservoir capacities are limited. Chain oilers are preferred where lower speeds and smaller shaft diameters are involved, inasmuch as a chain will normally have a greater arc of contact with the shaft, therefore being subjected to greater friction. More positive action with less slippage is claimed to result thereby. Chain links, however, cause a certain amount of churning and foaming in the oil,



Courtesy of The Hill Clutch Machine & Foundry Co.

Fig. 14.—Phantom view of a collar oiling bearing showing the flood of oil which is constantly fed to the wearing surfaces while the collar and shaft are in motion. The collar in this type of bearing also serves to take up end thrusts; therefore, no external collars are necessary unless such thrusts are extremely severe.

especially at higher speeds. Very low speeds, on the other hand, render both ring and chain oilers inefficient. Collar oilers, therefore, replace them in many cases of this nature. The collar oiler is fixed to the shaft, revolving therewith. It carries oil to the top of the bearing in



Courtesy of S. F. Bowser & Co., Inc.

Fig. 15.—Details of a circulating lubricating system installed on a steam turbine. Main bearings are indicated by "E," "F," "G" and "H." Packing glands by "M" and "N." The pump "A" takes oil from reservoir "B," passes it through cooler "C" and then to bearings via piping "D." Return piping is noted by "J."

much the same manner as the ring or chain oiler, but with more splash; essentially it is the connecting link between ring oiling and splash lubrication.

Ring, chain or collar oiling is to-day regarded by many as the simplest adaptation of the most efficient method of lubrication whereby the bearings are flooded with a considerable excess of oil over the amount that would theoretically be necessary to furnish the requisite oil film. By flooding the bearing with oil, the latter serves not only as a lubricant, but as well, a cooling medium to carry away part of the frictional heat developed, thereby reducing the temperature of operation. If the oil reservoir in the base of the bearing has been properly designed and is of sufficient capacity, this overheated oil will have ample opportunity to become sufficiently cooled by contact with the reservoir walls, after each circulation, particularly if the radiation of the latter is not interfered with. Lubricating systems of this type possess natural advantages in that the flood of oil which is constantly passing through the bearings, tends to wash out any grit, dirt, dust or metallic particles that may have gained entry. as a result, wear is reduced to a minimum. On account of this washing action of the oil however, the reservoir will gradually tend to accumulate a certain amount of sedimentary deposits. Therefore, it should be flushed out and cleaned at intervals, the old oil being replaced with new or purified oil. This is especially important when such a system is new and core sand, etc., may be present. In such cases several weekly changes are recommended. In all such systems the bearings must be absolutely level, otherwise oil will be scraped off. For the above reason such devices cannot be successfully used aboard ships.

It is evident that flood lubrication works on the opposite theory to that of supplying a bearing with just sufficient oil to furnish the necessary lubricating film. In fact, to-day in many types of machinery, flood lubrication is the only method allowed by the builder. On the other hand, there are many arguments in favor of regulated lubrication as embodied by the drip cup or automatic force-feed lubricator. For example, in the lubrication of the tractor engine, the automatic force feed lubricator is extensively used, whereby the oil passes once through the bearings and onto the cylinder walls. It is claimed that this method of lubrication reduces the possibility of crankcase dilution to a marked extent. Flood lubrication, however, is practically always automatic, depending for its action upon the operation of the machine which is to be lubricated, whereas drip or film lubrication is often subjected to regulation by the operator and any oversight on his part in starting or stopping the lubricator may give rise to bearing difficulties or excessive waste of oil.

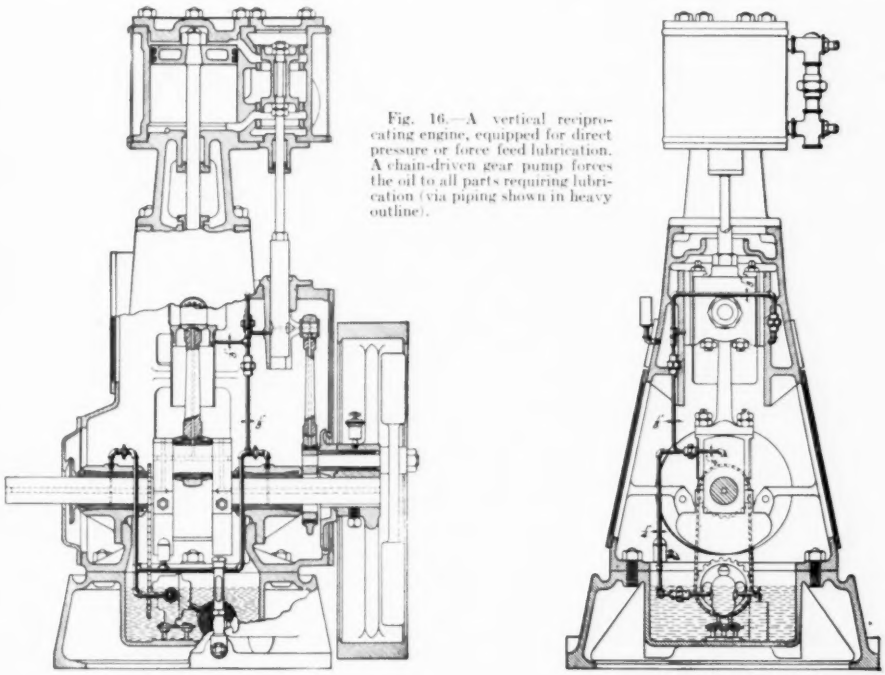


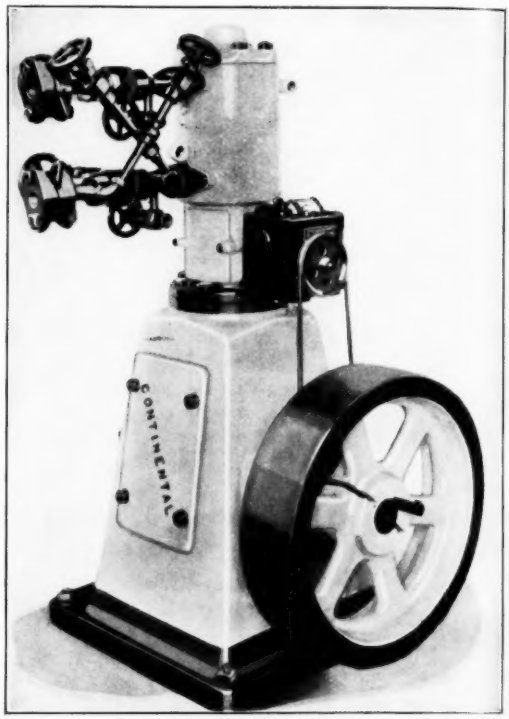
Fig. 16.—A vertical reciprocating engine, equipped for direct pressure or force feed lubrication. A chain-driven gear pump forces the oil to all parts requiring lubrication (via piping shown in heavy outline).

Courtesy of B. F. Sturtevant Co.

GRAVITY FEED SYSTEMS

The earliest application of lubrication by means of gravity feed, involved the manifold sight feed lubricator as explained heretofore. To an extent, it was the forerunner of the present gravity feed circulating system. Naturally the efficiency of any such system depends upon the height of the tank above the parts to be lubricated. Forced lubrication, however, is relatively inefficient unless it can be made circulating and therefore automatic in operation. As a result, in gravity feed systems of lubrication the oil tank is so located that there will be sufficient gravity head to enable a flood of lubricant to pass through the bearings with ample pressure to sustain the load involved. The oil is then recovered in the base of the machine or in suitable drip pans, often being purified before using again. In a circulating system it is then returned to the storage reservoir by means of a suitable oil pump which is usually operated by the main unit. Distribution of the oil to the bearings differs but little from the manifold system of drip lubrication, the oil pipes being often fitted with similar sight feed devices and regulating valves.

Gravity feed circulating systems are adaptable for the lubrication of any assembled piece of machinery where a number of bearings are involved, as for example, the crank pin bearings, crossheads, guides and main bearings of a reciprocating steam engine.

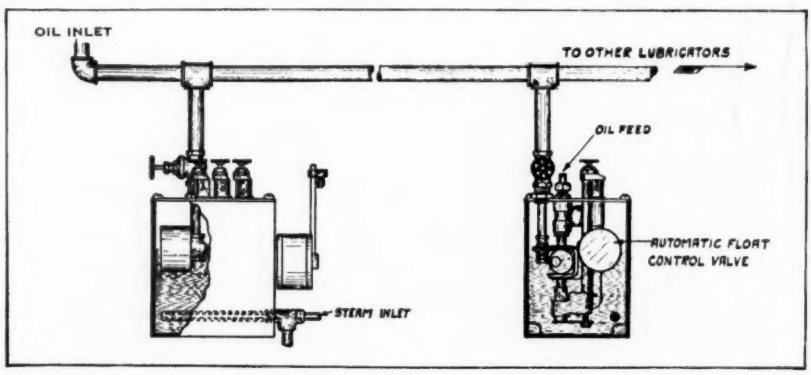


Courtesy of Detroit Lubricator Co.

Fig. 17.—Illustration of a mechanical force feed lubricator on an ice machine.

FORCE-FEED LUBRICATION

In order to obtain the most positive results from any lubricating system, it must as far as possible be absolutely mechanical and independent of the operator. All of the systems outlined above have their limitations. For example, ring, chain or collar oilers are not adaptable to excessively high speeds and pressures, and the action of gravity even in connection with a circulating oil pump, assumes a certain amount of uncertainty. In fact, installations involving large high speed steam turbines and generators, can only be dependably lubricated by circulating force-feed lubrication. In a system of this sort, there is generally no overhead storage tank installed, the necessary equipment, with the exception of the oil piping, being located either in the base of the machine or adjacent thereto. A suitable oil pump operated by the machine itself is located in the clean oil reservoir; its function is to force oil to all the bearings equally at a sufficient pressure to insure the requisite lubricating film. Inasmuch as this oil pressure is relatively constant, the resultant film is capable of supporting proportionately heavy loads; therefore, bearing surface areas can be somewhat reduced



Courtesy of S. F. Bowser & Co., Inc.

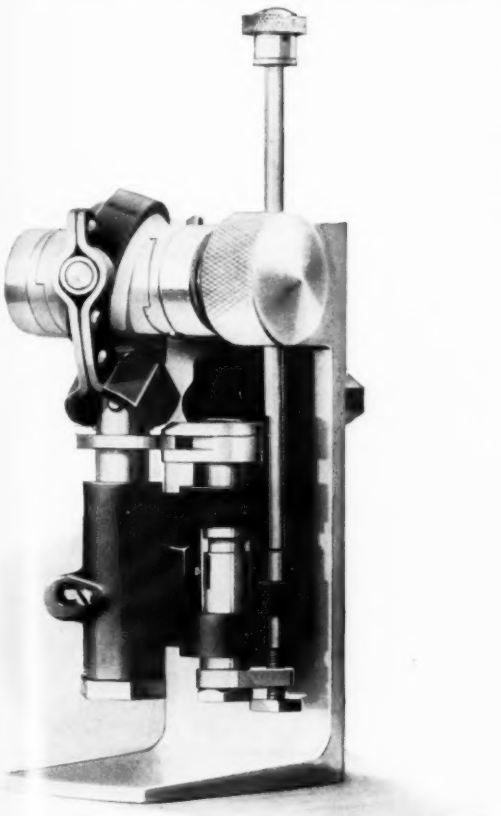
Fig. 18.—Force feed lubricators installed in conjunction with a central oil supply.

In a force-feed lubricating system, after the oil has passed through the bearings or over other wearing or sliding surfaces according to the type of machine, it drains by gravity back to the reservoir or oil sump which is usually installed in or adjacent to the base of the machine. Here it is cooled and perhaps a certain amount of it by-passed for purification before it is again pumped into the distributing system. Therefore the system must be so designed that the oil sump will have ample capacity to enable the returned oil to remain at rest for a sufficient length of time to cool and free itself of any water or other foreign matter which may have gained entry during its passage through the bearings. On this account, the pump suction should never be located too near the bottom of the reservoir for there will always be the possibility of a certain amount of sludge being present. We must remember that either water or sludge drawn into the system with oil may become the cause of emulsification and inefficient lubrication by stopping up the oil passages.

Courtesy of Greene, Tweed & Co.

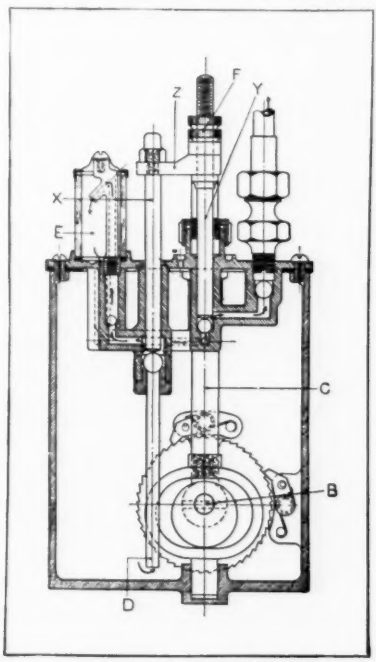
Fig. 19.—A double feed automatic lubricator of the ratchet drive type, equipped with sight feed devices.

It is of further interest to note the manner in which force feed lubricating pumps are installed. As a general rule, they are either geared directly to the main shaft of the machine on which they are to serve, or they may be chain driven or consist of rotary devices.



Courtesy of Madison-Kipp Corporation.

Fig. 20.—The essential parts of a valveless type of mechanical force-feed lubricator. The pumping plungers are operated or twisted up and down by means of a double motion eccentric above. Thus, as each is raised, oil is drawn in; at the top of the stroke the eccentric turns the plunger intake groove away from the inlet port in the barrel and registers the discharge groove with the discharge port. This position is held until the end of the down stroke.



Courtesy of McCord Manufacturing Co.

Fig. 21.—The mechanism of a ratchet driven mechanical lubricator. The main shaft "C" driven by eccentric "B," moves yoke "Z" and operates "X" and "Y," the primary and delivery plungers. "E" is the sight feed; "D" the oil inlet.

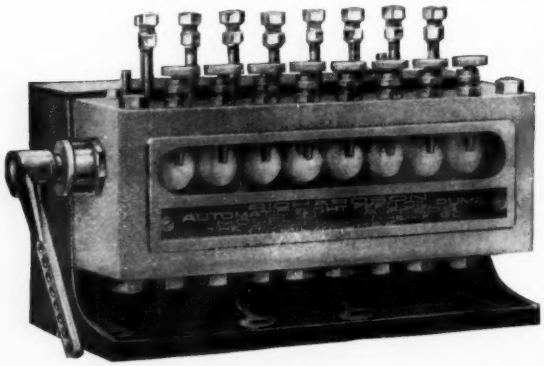
The latter are entirely submerged in the oil, being driven from the main unit by means of a chain and sprocket.

While force-feed lubrication is decidedly positive in action, it is naturally controlled by the operation of the pump and the capacity of the oil reservoir. In other words, if the pump breaks down, the oil flow will stop. Where an overhead gravity tank is installed, there is a certain amount of insurance against insufficient lubrication and overheating of bearings, inasmuch as the oil flow will continue until the tank has been emptied. If it is large enough, it may carry on lubrication of the machine, for the time necessary for making repairs without involving a shut-down. Again the pumps are often installed in duplicate and in this event, by cutting in the reserve pump, operation will be uninterrupted.

Force-feed lubrication systems are more intricate in construction than perhaps any other types of lubricating systems and usually therefore more expensive to install. In view of the advantageous results that are obtained, however, if handled with proper care, and intelligently overhauled and cleaned periodically, they will repay the initial expense in a short time.

MECHANICAL FORCE-FEED LUBRICATORS

Force feed lubrication can also be attained by the use of automatically operated oil manifolds known as mechanical force feed lubricators. Devices of this nature are operated under varying pressures by the machines to which they are attached. They can be built with any number of oil feeds, each being controlled by its individual pump within the oil reservoir.



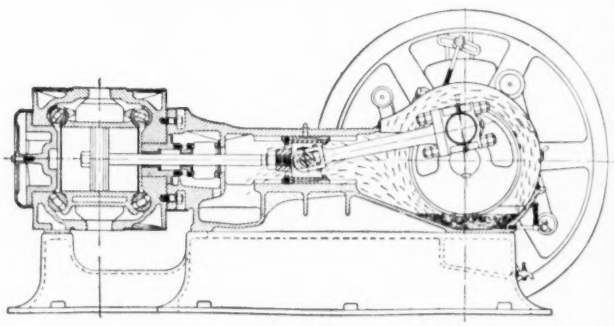
Courtesy of S. F. Bowser & Co., Inc.

Fig. 22.—Exterior view of a mechanical force feed lubricator.

Mechanical lubricators, being practically always driven by the machinery which they serve, only function when the latter is in operation, and at a proportional speed. The pumping capacity and rate of oil feed is therefore variable; by suitable adjustment of plunger strokes it can be very accurately regulated to meet whatever lubricating requirements may be involved.

SPLASH LUBRICATION

In certain types of engines and machines, the entire mechanism can frequently be enclosed in an oil tight casing in which event they are often lubricated by the relatively simple method of splash lubrication. This is especially adapted to vertical steam engines which are designed for the operation of power plant auxiliaries. It is also extensively used in oil engines, automobile and tractor engines. As a general rule, splash lubrication has three distinct advantages, i. e., it is cheap, relatively simple and involves but few accessory parts. Therefore it is perhaps one of the most dependable methods of lubrication in use to-day. This dependability is, however, only an assurance as long as the lubricating ability of the oil is not interfered with. We must remember that the oil in the crankcase of a splash system is practically always subject to rapid deterioration due to the churning it receives, the possibility for oxidation, the tendency towards higher temperatures due to the heat accumulations from the bearings and cylinders, the generation of emulsions with any water that may have leaked into the system, and the formation of sludges with any foreign matter, such as metallic particles, dust or dirt, which have gained entry.

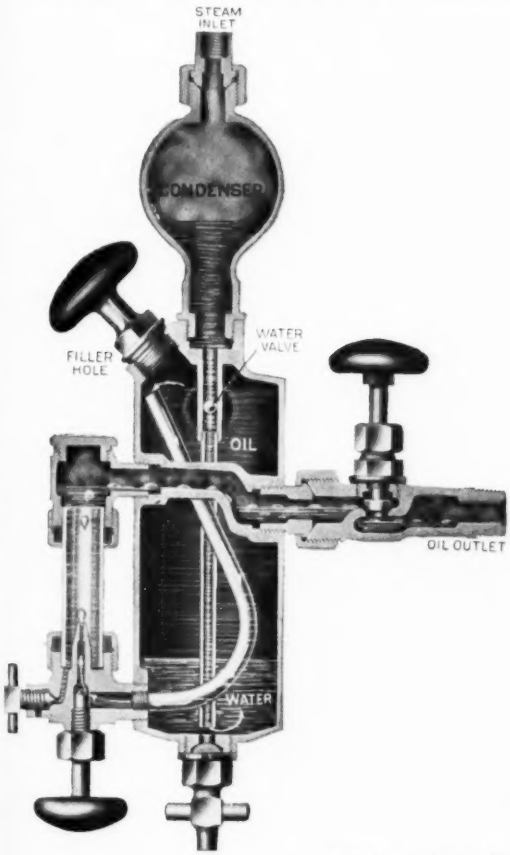


Courtesy of Industrial Oil Engineering. By J. R. Battle.

Fig. 23.—Cross section of a corliss engine showing splash lubrication of external parts.

In general operation, the crank disc serves as the medium by which the oil is delivered or splashed to the other wearing parts. The oil level is maintained at a sufficient height

so that as the crankshaft revolves, it will dip into the oil in the crankcase. By means of an attached dipper a certain amount of oil will thereby be thrown to the top of the crankcase



Courtesy of Michigan Lubricator Co.

Fig. 24.—Sectional view of a hydrostatic lubricator showing constructional details.

or cylinders, etc. From here it will be delivered through suitable oil grooves, pipes or ducts to the cross-head pin, governor mechanism, guides and crank pin bearings.

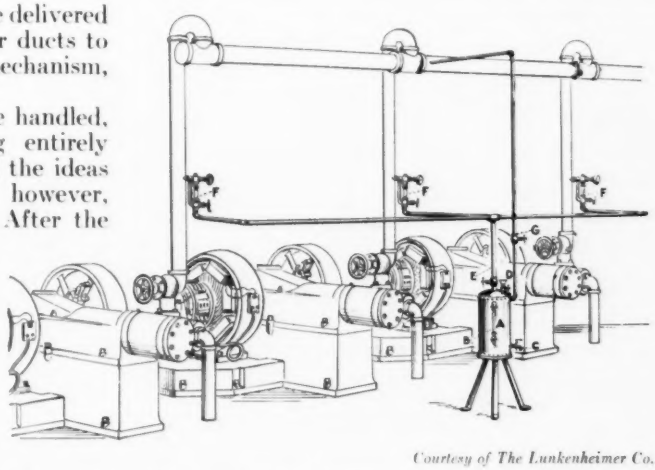
The means whereby the oil will be handled, are many and devious, depending entirely upon the design of the machine and the ideas of the builders. They all must, however, involve the same basic principles. After the oil has served the wearing parts, it is usually then returned to the crankcase by gravity. It is quite possible, however, to by-pass a certain amount of it through the oil purifier if so desired.

An essential feature with any splash system, is the installation of a suitable oil gauge and drain cock near the base of the crankcase in order to enable the operator at all times to see how much oil there is in his case, and also to draw off any water which may have accumulated. In practically every instance, it is advisable to pay particular attention to these matters. Water is especially detrimental in any splash lubricating system except in engines which are designed to be specifically lubricated by emulsions of oil with water. As a general rule, particularly in vertical steam engines, water will find its way into the crankcase as condensed steam through leaks in the stuffing boxes. In order to eliminate this to a certain extent, baffle plates or secondary stuffing boxes are installed by many builders.

HYDROSTATIC (STEAM CYLINDER) LUBRICATORS

Another automatic oiling device which also requires consideration is the hydrostatic steam cylinder lubricator. The systems explained above with the exception of the mechanical force-feed lubricator, are generally only adaptable to external or bearing lubrication, but in practically every steam reciprocating engine (except perhaps the vertical marine type), it will also be necessary to lubricate the cylinder walls, valve seats, rings, rods and throttle valves. This can be best effected by "lubricating the steam" or in other words injecting a certain amount of lubricant into the steam before it enters the valve chest. Thereby the steam will serve both as an atomizing agent and as a carrier, and the finely divided particles of oil will be distributed to all parts of the valve chest and cylinder with which they come in contact.

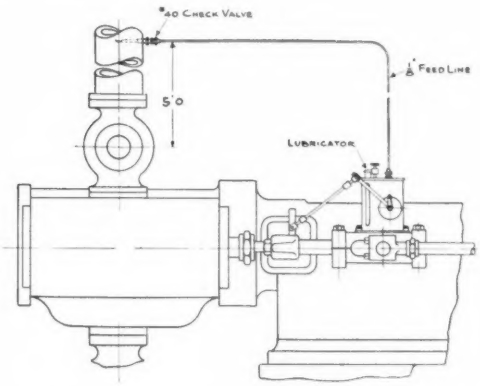
In order to insure successful steam cylinder lubrication the lubricator must be positive in



Courtesy of The Lunkenheimer Co.

Fig. 25.—A central tank multiple feed, hydrostatic lubricating system. "A" is the oil storage reservoir; "F" the respective lubricators.

action, dependable, and capable of feeding oil to the steam drop by drop at any desired frequency. In the early days of steam cylinder lubrication it was generally the custom to feed a certain amount of oil periodically to the valve chest or cylinder by means of some crude form of oil cup or hand pump. Lack of effective distribution of the lubricant however, proved this method to be relatively inefficient, and today the hand pump is only used as an emergency device or to help out the hydrostatic or mechanical lubricator under abnormal operating conditions.

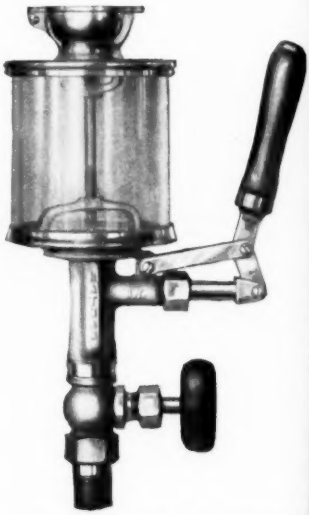


Courtesy of S. F. Bowser & Co., Inc.

Fig. 26.—Method of mounting a mechanical lubricator for steam cylinder lubrication on a high speed engine. Note drive connection from valve rod.

The hydrostatic lubricator operates by virtue of the weight of a certain volume of water which is contained either in the condenser bulb or pipe. If sufficient in volume to overcome the steam pressure, the weight of this water will force oil drop by drop from the lubricator reservoir into the steam pipes. In order to insure the accumulation and continual maintenance of the necessary volume of water the condenser connections of a double-connected single-feed hydrostatic lubricator, must enter the steam pipe about two feet above the oil inlet. In a multiple feed lubricating system, however, the necessary hydrostatic head is obtained by running a pipe connection from the main steam header down to the central storage tank. In either case the principle of operation is the same, involving the maintenance of the requisite pressure difference to force the oil into the steam line by means of the atomizer inserted therein.

The mechanical force-feed lubricator as discussed heretofore is also especially suitable for steam cylinder lubrication due to the fact that it is positive in action, economical in the use of oil, and automatic in supplying just the right amount of oil commensurate with the speed of the engine. Furthermore certain disadvantages inherent in the hydrostatic lubricator are eliminated, such as the danger of clogging, the susceptibility to temperature changes, and the possibility of pressure variations. On the other hand the mechanical force feed lubricator is relatively more expensive to install and has a low capacity as compared with a multiple feed central tank hydrostatic system.



Courtesy of Nathan Manufacturing Co.

Fig. 27.—A hand cylinder oil pump often used as an auxiliary to the sight feed or mechanical lubricator on large engines.

CONCLUSION

Lubricating equipment is important inasmuch as it is the ultimate factor in the attainment of efficient lubrication. Therefore it behooves the consumer of lubricants to study the constructional details of whatever devices he may have to use in connection with the lubrication of his machinery. The adaptability of many of the lubricators discussed heretofore is extensive and varied. Machine design is the controlling factor in many cases; on the other hand but a slight alteration will often make practical the substitution of a different system of lubrication which may meet operating requirements far more satisfactory.

Operating conditions are essentially the "acid test" of any lubricant or lubricating system. Neither the machine builder nor the oil refiner can anticipate these absolutely in the design and make up of their products. It is strictly up to the operator, therefore to study:

First —His operating conditions,

Second—The limitation of his lubricating systems, and

Third —The ability of his lubricants to function properly under the above requirements.

If he heeds these three cardinal points in the purchase of his lubricants the lubrication of his entire plant should rarely give trouble. In fact it should become one of the pleasures of efficient plant operation.

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